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Motor Vehicle Emissions Inspection/Maintenance Program for South Carolina

Systems Control, Inc, Anaheim, CA

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Executive Summary

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16. ABSTRACT

This report presents an analysis of alternative motor vehicle basic inspection and maintenance programs in terms of related costs and benefits for the State of South Carolina with specific information covering Lexington, Richland, Charleston, and Berkley Counties. The study methodology used is described and includes collecting data, determining criteria for selecting alternative program configuration, screening program option and evaluating alternative configuration selected through the screening process. Program alternatives were evaluated in terms of emission reduction attainable, geographic coverage, effective motor vehicle population, consumer protection, quality assurance, costs and financial feasiblity.

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MOTOR VEHICLE EMISSIONS INSPECTION/MAINTENANCE PROGRAM FOR SOUTH CAROLINA

EXECUTIVE SUMMARY

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ABSTRACT

This document was prepared to assist the South Carolina Department of Highways and Public Transportation (SCDHPT) in the evaluation and development of a Motor Vehicle Inspection/Maintenance (I/M) program for the State. I/M was designated by the Clean Air Act Amendment of 1977 as a method by which ambient air quality standards may be achieved by 1982. If standards cannot be attained by 1982, an extension of compliance to 1987 may be obtained, in which case I/M implementation will be mandatory.

This report presents an analysis of costs and benefits associated with a basic I/M program that could be implemented in South Carolina. Study efforts were limited to nonattainment geographic areas over 200,000 population, namely Berkeley, Charleston, Lexington, and Richland Counties. For comparative purposes, a cost analysis for a decentralized statewide program was also performed. Three alternative options for administration of an I/M program were studied; state operation, contractor operation, and private-garage operation.

Based upon cost information, the preferred option selected by the State was the private garage integrated with an existing safety program. Due to increased equipment and operating costs, only the idle-mode option was investigated.

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EXECUTIVE SUMMARY

A. WHY AN INSPECTION/MAINTENANCE (I/M) PROGRAM

Recent ambient air quality data for the State of South Carolina indicates violations of the National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO) and photochemical oxidants. Because of these violations, the Environmental Protection Agency (EPA) and the State of South Carolina Department of Health and Environmental Control, designated the urban areas of Columbia and Charleston as non-attainment. These national standards have been established in order to protect the health and welfare of the population. Both CO and O_x are gases which, in sufficient concentrations in the atmosphere are potentially harmful to the public health.

A major source of CO and photochemical oxidants in South Carolina are motor vehicles. Carbon monoxide is a product of incomplete combustion of an internal combustion engine. Photochemical oxidants are indirect products, formed through a complex series of atmospheric reactions of two other direct products of combustion, reactive hydrocarbons (HC), and oxides of nitrogen (NO_x) in the presence of sunlight. An I/M program is a cost-effective strategy to reduce CO and HC emissions from motor vehicles. By significantly reducing the emission of HC and CO from in-use vehicles in South Carolina, an I/M program will enhance the attainment of NAAQS.

The Clean Air Act Amendments (CAAA) of 1977 have specific provisions that require the establishment of I/M programs. According to the CAAA the state was to submit revisions to its State Implementation Plan (SIP) by January 1979, which specifies methods to achieve the NAAQS. These methods include control of stationary sources of air pollution and various transportation control measures whose objective is to reduce vehicle miles traveled (VMT) and hence,

reduce pollution from mobile sources. If, in these revisions, the state cannot demonstrate attainment of the NAAQS by 1982 using all reasonably available pollution control measures, then an extension to 1987 can be requested. If an extension is granted a mandatory I/M program will be required by the CAAA. Based upon the SIP provisions, the NAAQS can not be attained in Berkeley, Charleston, Lexington and Richland Counties of South Carolina by December 1982. The CAAA of 1977 provides that if a nonattainment area does not implement a mandatory program, then Federal funds will be withheld for 1) highways, except safety, mass transit, or transportation improvement programs related to air quality improvements; 2) sewage treatment grants; and 3) air quality planning grants.

1. Inspection/Maintenance Programs

Inspection/Maintenance is a two-phase emission control program applied periodically to all in-use vehicles. The inspection (Phase 1) of an I/M program serves as a screening procedure to identify vehicles having emissions which exceed established standards. The maintenance (Phase 2) of an I/M program involves the repair of those vehicles that exceed the established standards. Vehicles that have failed the inspection phase are required to obtain corrective repair in order to pass inspection retest.

The Federal Motor Vehicle Control Program (FMVCP) was established to ensure that new cars, off the assembly line, are designed to meet increasingly stringent emission standards. Federal testing of in-use vehicles throughout the United States has demonstrated that motor vehicles are not meeting the emission standards for which the vehicles were designed. The reasons they exceed the standards include: improper or inadequate maintenance, tampering, defective emission control devices, and fuel switching. Regardless of the cause, it has become clear that some in-use vehicle emission inspection programs are necessary to ensure that the emission controls on vehicles continue to operate as they were intended over their useful life.

a. Program Organizational Approach

A variety of approaches have been used to run I/M programs, but the major types are generally in three organizational categories:

1. State - Centralized test facilities operated by state, city, or local government.

2. Contractor - Centralized test facilities operated by a private corporation under contract to the State.

3. Private Garage - Decentralized test facilities operated by private automobile service garages, certified or licensed by the State.

Each type of administrative program is compared qualitatively by identifying responsibilities, functions, and roles in the emission test process as shown in Table 1. In each program, the State plays an integral part by auditing records, maintaining quality control checks, certifying contractor or private stations, and assuring consumer protection.

b. Background Information on Present I/M programs

Inspection/maintenance programs currently operating throughout the country are presented in Table 2. All available information is summarized under the following categories: program type, size of subject vehicle population, emission test, station requirements, cost (i.e., capital and operational), and consumer fee charges.

Govenment I/M programs can be further subdivided into either state or municipally-owned/operated programs. New Jersey operates a state program that annually idle-tests 3.9 million light-duty vehicles (LDVs) at 38 stations (62 lane total capacity). This requires $2.5 and $1.3 million dollars in capital and operating costs, respectively. Oregon idle-tests 0.55 million vehicles at 7 inspection stations on a biennial basis in the City of Portland. Capital costs are $0.38 million dollars for leased facilities, and operating costs are $2.22 million dollars. Consumer fee is estimated at $5.00 per vehicle.

Table 1. QUALITATIVE COMPARISON OF ADMINISTRATIVE PROGRAM OPTIONS

COST CATEGORIES AND CONSIDERATIONS	STATE-OPERATED	CONTRACTOR-OPERATED	PRIVATE GARAGE-OPERATED
Instrumentation and Technology	Design, requirements analysis, and specification development is required.	Will have expertise in these areas.	Will have some basic expertise, but will need to be expanded.
Site Acquisition	Initial capital cost required.	Low capital cost to state, deferred to operational charge.	Capital invested already.
Facility Construction and Acceptance	Capital investment required, local government approval to meet zoning laws.	Contractor agency will require building inspection approval by the State and local government.	Facilities available.
Equipment Acquisition and Installation	Volume discount.	Moderate cost volume discount.	Each participating garage will have to purchase equipment that it does not already have.
Maintenance and Support, Inspection-Oriented Equipment	Preventive maintenance done by facility personnel; major corrective maintenance done either by a single technical department or contracted outside service; moderate cost to State.	Minor corrective maintenance done by facility personnel; major corrective maintenance done by contracted service; no cost to State.	Preventive and minor corrective maintenance done by facility personnel; major corrective maintenance probably done by contracted service; no cost to State.
Quality Control and Support Activities	Periodic confidence testing and calibration functions; minor repairs of supporting equipments done by facility personnel; major repairs done by single department or contracted; moderate cost to State.	Periodic confidence testing and calibration of minimum number of stations by state. Data processing by state.	Performed by State agency. Numerous stations to be checked. Data processing input from card decks.

Table 1. QUALITATIVE COMPARISON OF ADMINISTRATIVE PROGRAM OPTIONS (Continued)

COST CATEGORIES AND CONSIDERATIONS	STATE-OPERATED	CONTRACTOR-OPERATED	PRIVATE GARAGE-OPERATED
Program Management and Functions	Maintain records, schedule vehicles, collect fees, review emission results, update standards and documentation, determine future requirements, evaluate newer equipments, determine budgetary requirements, and other program management functions; may involve many separate State agencies, new and/or existing; moderate cost to State.	Similar management functions to State operated program, but with State agency that oversees contractor administration; moderate cost to State.	Requires State to audit all records on regular basis; high cost to State.
Program Management and Administration Surveillance Program	Periodic certification of existing facilities; qualification/certification of new facilities; moderate cost to State.	Periodic certification of contractor facilities by State inspection team; moderate cost to State.	Private-operated facilities certified by State personnel; high cost to State.
Initial Personnel Training and Indoctrination	Single department responsibility; uniform training policy, course content; minimum quantity of trained instructors, equipment, buildings; moderate cost to State.	Require single department responsible for training, etc.; minimal cost to the State.	Possibly many diverse training policies, course contents, equipment, facilities, instructors; requires guidance from State agency on requirements; minimal cost to State.
State Qualification and Certification	Single departmental responsibility; uniform qualification and certification policies; minimum quantity of technical and administrative personnel; moderate cost to State.	State responsibility to supervise initial operation of program; moderate cost to State.	Mandatory that State qualify and certify stations; high cost to State.

Table 1. QUALITATIVE COMPARISON OF ADMINISTRATIVE PROGRAM OPTIONS (Continued)

COST CATEGORIES AND CONSIDERATIONS	STATE-OPERATED	CONTRACTOR-OPERATED	PRIVATE GARAGE-OPERATED
Vehicle Scheduling	Single departmental responsibility.	Mandatory that State be responsible.	Mandatory that State be responsible.
Facility Inspection Personnel Salaries, wages, etc.	Technical rating dependent on test regime; cost proportional to technical requirements; salaries and benefits must be competitive to attract higher-rated personnel; high cost to State.	Technical rating dependent on test regime requirements.	Technical rating depends on test regime; cost proportional to technical rating.
Quality Assurance	Responsible for complete audit of all records; complete data analysis; adjusting confidence limits; moderate cost to State.	Calibration records frequently audited by State personnel; State responsible for complete data analyses; moderate cost to State.	Difficult to implement because of instrument differences, diversified personnel; high cost to State.

Table 2. EXISTING I/M PROGRAM SUMMARY

PROGRAM TYPE	STATE	ADMINISTRATIVE AGENCY	VEHICLE POP (Millions)	TEST MODE AND STRINGENCY[a] L.D.V.	H.D.V.	STATION STATUS #Lanes	#Sta.	Mobile	COST (Millions $ Yr) Capital[b]	Operating[b]	INSPECTION FEE
I. GOVERNMENT											
A. State	New Jersey	DMV - EPA	3.9 LDVs	Idle 23%	NA	62	38	1	$2.50 (1972) +	$1.33	$3.50 including safety
	Oregon[c] Portland	Dept. of Environ. Qual.	0.55 LDVs (biennial)	Idle 40%	NA	14	7	1	$0.38 Leased facil. (1975)	$2.22	$5
B. Municipal	Ohio, Cincinnati	Cincinnati APCD[d]	0.2 LDVs	Idle 30%	NA	4	1	None	$0.013 safety facil.	$0.13 for	$3.75 including safety
	Illinois, Chicago	Chicago Dept. Env. Control	1.1 LDVs	Idle 30-35%	NA	10	5	6	$2.0 (1973)	$1.45 (1977)	Free[e,f]
II. CONTRACTOR	Arizona,[g] Maricopa and Pima counties	Ariz. Dept./ Health Ser.	1.1 cars, trucks, and motorcycles	Idle[h] 30%	EPA City	36	12	1	$10.5	$4.0	$5
III. PRIVATE GARAGE	Nevada (Clark Co. only)	Dept. Motor Vehicles and Dept. Human Resources	0.20 LDVs	Idle	NA	218 Licensed Private Stations			$0.17 (1974)	$0.43 approx. (1974)	$10.00-$33.00 (including adjustments)
	Rhode Island	Dept. of Transportation	0.5 LDVs	Idle 30%	NA	923 Private Garages + 1 State-Operated challenge lane			$1.00 (1977)	Part of Capital cost 1st year	$4

[a]Percent of vehicle failing to meet established standards.

[b]Cost data defined per particular year. To upgrade costs to present year multiply by appropriate inflation factor.

[c]State of Oregon, Oregon Environmental Quality Commission - "Report to the Oregon Legislature on the Motor Vehicle Emission Testing Program," January 14, 1977.

[d]Air Pollution Control Department.

[e]Included as part of the registration fee.

[f]Chicago's program costs are covered by a city sticker fee.

Definitions: DMV - Department of Motor Vehicles.
LDV - Light-Duty Vehicle (GVW <8501 lb.).
HDV - Heavy-Duty Vehicle (GVW >8500 lb.).

[g]State of Arizona, Bureau of Vehicular Emissions Inspections - "Tune-up for Less Emission - It's Working Arizona Vehicular Emissions Inspection Program Operations", 1977.

[h]Loaded test with only idle fail/pass standards.

Municipally-operated programs are found in Ohio (Cincinnati), and Illinois (Chicago). These programs annually inspect 0.2 to 1.1 million vehicles. Ohio has only one test facility, but intends to expand the program later. Illinois currently operates five 2-lane capacity test facilities. In addition, Illinois operates six mobile test facilities. Ohio capital cost is $13,000 and operating cost is $0.13 million. Illinois expenditures are $2.0 million for capital costs and $1.45 million annual operating expenses.

The only contractor-owned/operated program is located in Arizona (Maricopa and Pima Counties). The 12 test facilities annually process an estimated 1.1 million cars, trucks, and motorcycles using 30 percent stringency factor with idle test requirements. Capital cost expenditures are estimated at $10.5 million with annual operating costs approaching $4.0 million.

At present, Nevada and Rhode Island are the only states that have private garage-operated I/M programs. Rhode Island has an extensive program, testing 0.5 million vehicles at 923 certified private garages. The Nevada program is comparatively smaller, licensing only 218 garages to test 200,000 vehicles. As expected, the capital cost expenditure for Rhode Island is quite large compared to Nevada. Unexpectedly, the cost to the motorist is quite high for Nevada ($10.00 to $33.00) compared to Rhode Island ($4.00). However, the Nevada program does have vehicle adjustment included in the test requirements.

For each I/M program type, typical problems encountered during implementation, and their subsequent solutions, are shown in Table 3. Additional information includes representative achievements for each state I/M program.

2. I/M Implementation Schedule

In producing an I/M SIP revision, the state must provide for:

1. An analysis of the benefits and costs of the program,
2. A public information effort,
3. A legislative proposal, and
4. A schedule for I/M implementation.

Table 3. TYPICAL I/M PROBLEMS, SOLUTIONS AND ACHIEVEMENTS

PROGRAM TYPE	STATE & RESPONSIBLE AGENCY	PROBLEMS	SOLUTIONS	ACHIEVEMENTS
I. GOVERNMENT-OPERATED				
A. State-Operated	California	.(Pilot Program) Minimal Problems		.Public Reaction Excellent .Unique Combination of Exhaust Analysis, Engine Monitoring, and Computer Technology .Diagnostic Testing
	New Jersey	.2-Year Exemption for New Cars .Lack Operating Capital Capacity Improvements Cannot be Made .DMV Resistant to Increased Refailure Rate Expected in Phase III standards (23%) .Refailure Rate is 25%	.Legislation Pending .Funding Has Increased $330,000 .No Position Change .Refailure Rate Now 11%	.Nation's Longest On-Going I/M Program .4,700 Garages Now Utilizing Exhaust Analyzers .Private Garage Reinspection Program
	Oregon Portland	.Biennial Inspection Lowers Program Effectiveness, Created Cash Flow and Personnel Problems .Tampering	.Inspection Period Will be Shortened .Trying to Implement An Annual Inspection Cycle, Requires Legislation Action	.Estimates Reduction of HC is 14% and CO 7% .Private Garage Acceptance is Increasing
B. Municipal-Operated	Ohio Cincinnati	.Low Throughput .Inadequate Enforcement .No Phase-In Period and No P.R. Program .Mechanics Inadequately Trained	.Improved Enforcement Led to Increased Throughput .P.R. Program Needed .Mechanic Training Program	.Demonstrated Short Lead Time in Adding I/M Program to Safety Program
	Illinois Chicago	.Less Than 20% of Registered Vehicles Have Been Inspected	.Increased Enforcement Policies .Favor Mandatory Inspection with Three Conditions: 1. Fed. Govt. and Auto Manufacturer's Concurrence On Warrantee Program 2. Auto Manufacturer's Compliance With Existing Statutory Emission Standards 3. I/M Implementation Over Regional Area	.Communication Channels Established with Auto Manufacturers Regarding High Emission Levels of Late Model Vehicles .Nation's First Fully Automated Inspection Program

Table 3. TYPICAL I/M PROBLEMS, SOLUTIONS AND ACHIEVEMENTS (Continued)

PROGRAM TYPE	STATE & RESPONSIBLE AGENCY	PROBLEMS	SOLUTIONS	ACHIEVEMENTS
II. CONTRACTOR-OPERATED	Arizona Maricopa and Pima Counties	.Initial Adverse Public Reaction .Queuing Problems .Tampering .Inadequate Inspector Training	.Expected to Disappear With Increased Efficiency and Better Public Awareness .Needs Contractor Monitoring	.Nation's First Contractor-Operated Program
III. PRIVATE GARAGE-OPERATED	Nevada Clark County	.Minimal		.DMV Control of Licensing of Stations and Inspectors .Minimal Cost
	Rhode Island	.Inadequate Training of Garage Mechanics .Some Garages Violated Regulations	.On-Going Mechanic Training Program .Constant Monitoring Needed	.Program Initiated by Governor and Rhode Island DOT With Backing From Executive and Legislative Branches .State-Run Inspection Facility Used as Reference Station

Before January 1, 1979, an SIP revision was prepared by DHEC and submitted to the EPA. As a part of the SIP revision submittal itself, a commitment was made by the Governor to implement the I/M program in accordance with the schedule submitted. This schedule is in accordance with Reference 1. Quoting from Reference 1:

"C. Authority To Implement I/M

Normally, adequate legal authority to implement a SIP revision must exist for a revision to be approved. Where a legislature has had adequate opportunity to adopt enabling legislation before January 1, 1979, the Regional Administrator should require certification that adequate legal authority exists for I/M implementation by January 1, 1979. However, for many states there will be insufficient opportunity to obtain adequate legal authority before their legislatures meet in early 1979. Therefore, a certification of legal authority for the implementation in these states must be made no later than June 30, 1979. An extension to July 1, 1980 is possible, but only when the state can demonstrate that a) there was insufficient opportunity to conduct necessary technical analyses and/or b) the legislature has had no opportunity to consider any necessary enabling legislation for inspection/maintenance between enactment of the 1977 Amendments to the Act and June 30, 1979. Certification of adequate legal authority, or other evidence that legal authority has been adopted, must be submitted to the EPA Regional Offices to be included in the SIP revision already submitted. Failure to submit evidence of legal authority by the appropriate deadline will constitute a failure to submit an essential element of the SIP...."

"D. I/M Implementation Deadlines

Implementation of I/M 'as expeditiously as practicable' shall be defined as implementation of mandatory repair for failed vehicles no later than 2-1/2 years after passage of needed legislation or certification of adequate legal authority for new centralized systems (State or Contractor-operated), and 1-1/2 years after legislation or certification for decentralized systems which are adding emission inspections to safety inspections. For the normal legislation deadline of June 30, 1979, new centralized programs must start by December 31, 1981, and all others must start by December 31, 1982, while all other programs must start by December 31, 1981. Where I/M can be implemented more expeditiously, it must be. Each state implementation schedule must be looked at individually to determine if it is as expeditious as practicable...."

B. BACKGROUND OF THIS STUDY

In order to comply with requirements of the CAAA of 1977, Systems Control, Inc. (SCI), was contracted to study alternative I/M options.

The initial effort was the development of background data regarding the technical and administrative aspects of I/M programs. A summary report which described I/M program elements and other states' experience in I/M and various technical memoranda, was produced to assist in the selection of a preferred option.

The purpose of this report is to analyze the preferred option in terms of cost and benefits such that the Department of Highways and Public Transportation (DHPT) may consider it as a viable option in their SIP to meet NAAQS.

The Preferred Option - As indicated earlier, the DHPT selected the decentralized preferred option of an idle test conducted by private garages measuring HC and CO combined with the existing safety inspection program. The two alternative program scenarios studied are shown in Table 4.

Table 4. PREFERRED OPTION PROGRAM CONSIDERATIONS

PROGRAM CONSIDERATION	SCENARIO 1	SCENARIO 2
Benefits	yes	yes[a]
Costs	yes	yes
Geographic Coverage (see Figure 1)	4-County	Statewide
Inspection Enforcement	Annual Vehicle Registration	Annual Vehicle Registration or Window Sticker

[a]Emission data extrapolated from 4-County data.

In addition to the program considerations listed in Table 4, there are a number of support services that are important to I/M effectiveness and cost, but do not directly influence option selection. These support services include:

- Quality Assurance
- Mechanic Training

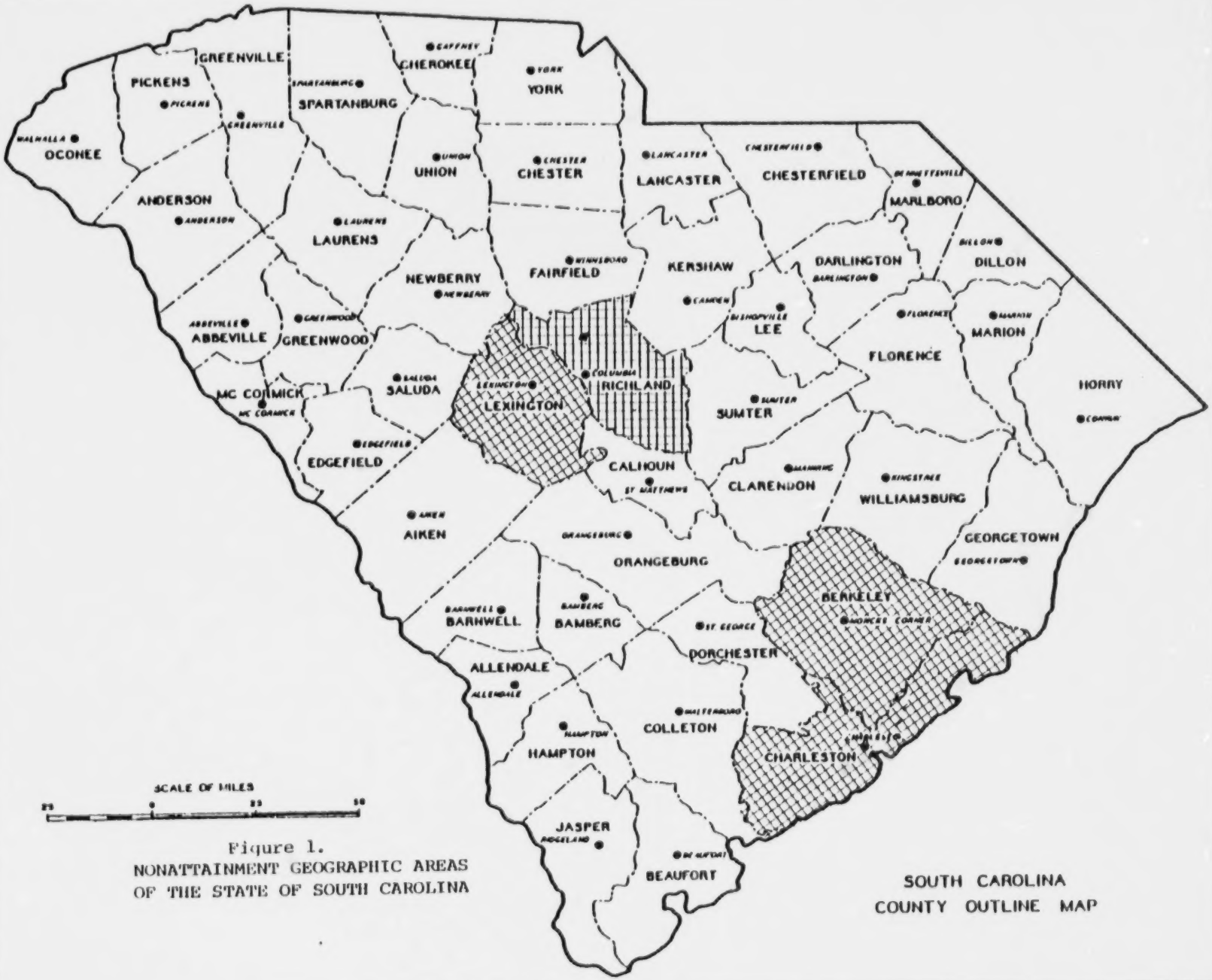

Figure 1.
NONATTAINMENT GEOGRAPHIC AREAS
OF THE STATE OF SOUTH CAROLINA

- Consumer Protection
- Public Education

The eventual implementation of the preferred option will require the cooperation of several different state offices internal to the DHPT. Figure 2 provides a functional outline of the DHPT as it relates directly to I/M needs and requirements. Use of existing facilities, services and resources should greatly reduce the cost of support services.

C. STUDY FINDINGS

1. Assumptions

The methodology used in this report was based upon the following assumptions:

- The program operation is over a period of 10 years
- The private garages would assume the cost of purchasing test equipments.
- Vehicle Population Growth
  1976 to 1982 - 4 percent
  1982 to 1992 - 3.5 percent
- Capital Investment Per Station
  $3,000. - Cost of emission testing and auxiliary equipment
- Operations Throughput Time
  3.75 minutes
- Mechanics Costs (including overhead)
  $18. per hour

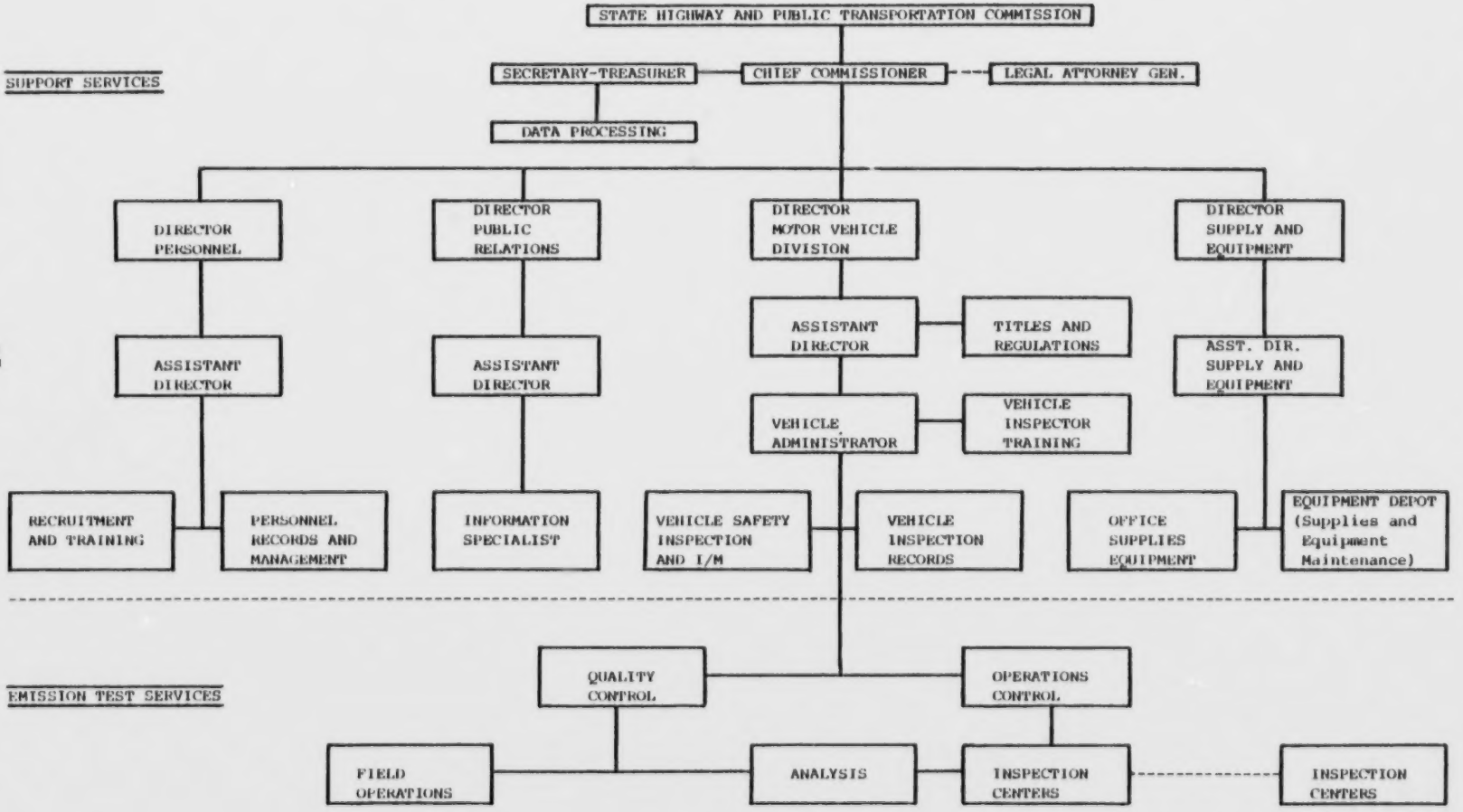

Figure 2. SOUTH CAROLINA I/M RESPONSIBILITY CHART

- All current safety inspection facilities will participate in the I/M program and there will be no increase in the number of facilities over the life of the I/M program

- Station inspection load factor capability - 10 percent. NOTE: In the four-county area with safety inspection stations, the load factor for emissions testing is about 3 percent.

- Emissions for statewide option were developed by extrapolating the four-county data.

- Cost of capital is 6 percent for the State.

- The State personnel benefits including sick leave, vacation, retirement, insurance, holidays, etc., is 25 percent of base rate.

- Fuel cost is $0.70 per gallon.

- Inflation rate is 7 percent. To convert from 1978 to 1983, a compound factor of 1.403 must be used.

- Indirect costs reflecting the cost to consumers for waiting time at inspection lanes and cost of transportation to and from the inspection and repair facilities were ignored.

- Average miles traveled per year for LDVs is 11,500 miles per year.

- Failed vehicles consumed, on an average, 3.8 percent more fuel than the certified vehicle.

- Assumed miles-per-gallon fleet average for LDVs is 15 miles-per-gallon (1982), 24 miles-per-gallon for 1987 LDVs.

2. I/M Program Costs

a. I/M Program Costs

The major cost components for the four-county and statewide options are summarized in Tables 5 and 6. The costs are identified as to state costs necessary to administer and conduct surveillance of the private-garage program, and operation and capital costs assigned to the private garage.

1. Four-County Option - It has been estimated that 671 private garages, distributed in the four counties as noted in Table 5, will actively participate in the I/M program. This will require a 10-year expenditure by the private garages of $4.0 million and $9.9 million for test equipment and facility operations, respectively. During this same period, the State will expend $4.9 million for capital, operation, and implementation costs. Total I/M expenditures by state and private garages for a 10-year program duration is estimated at $18.9 million.

   The private garage capital/expenditure of 4.0 million is the accumulated first time instrumentation costs of $3,000 and a 5 year replacement cost for a total of $6,000 per private garage - (6,000 x 671 = $4 million). The private garage-operation cost of 9.9 million are for the 671 private garages over the 10-year program at an operating cost per private garage over the 10 years of $14,800 or an average of $1,500 per year. Therefore, the total average cost per private garage per year is $2,200.

   The state costs of $4.9 million or an average of $40,000 per year over the 10-year program is for 3.2 million operating costs for administrative support analysis of data, prepare reports and administer the program including consumer protection, 1.2 million for quality control of 671 private garages, $200,000 for one time public information program, 1.2 million for quality control equipment, 8.5 thousand for office equipment, $78,000 for vehicle for complaint investigation

Table 5

COSTS OF SOUTH CAROLINA I/M PROGRAM - FOUR COUNTIES OPTION
($1,000 1978 Dollars)

CATEGORY	1982-1986		1987-1991		TOTAL	
	State	Private Garage	State	Private Garage	State	Private Garage
I Test Equipment Costs[a]	0	2,013.0	0	2,013.0	0	4,026.0
II Operating Costs						
Facility Operation	0	4,562.9	0	5,351.6[b]	0	9,914.5
Administrative Support	1,616.5	0	1,616.5	0	3,233.0	0
Quality Control	612.0	0	612.0	0	1,224.0	0
III Initial Implementation Costs	61.5	0	0	0	0	61.5
Public Information	200.0	0	0	0	0	200.0
IV Other Capital Costs						
Administrative Office Equipment	8.5	0	0	0	8.5	0
Quality Control Equipment	119.0	0	0	0	119.0	0
Consumer Protection	78.0	0	0	0	78.0	0
TOTAL	2,695.5	6,575.9	2,228.5	7,364.6	4,924	13,940.5
TOTAL STATE & PRIVATE GARAGE	9,271.4		9,593.1		18,864.5	

[a]Number of private garages participations in the program are:

Berkeley County	47
Charleston County	235
Lexington County	124
Richland County	265

[b]Facility operation costs increased to compensate for increase in the vehicle population.

Table 6

COSTS OF SOUTH CAROLINA I/M PROGRAM - STATEWIDE OPTION[a]
($1,000 1978 Dollars)

CATEGORY	1982-1986		1987-1991		TOTAL	
	State	Private Garage	State	Private Garage	State	Private Garage
I Test Equipment Costs[b]	0	9,405.0	0	9,405.0	0	18,810.0
II Operating Costs						
Facility Operation[c]	0	13,053.6	0	15,508.5	0	28,562.1
Administrative Support[c]	7,552.5	0	7,552.5	0	15,105.0	0
Quality Control[c]	2,859.3	0	2,859.3	0	5,718.6	0
III Initial Implementation Costs[c]	202.0	0	0	0	202.0	0
Public Information	200.0	0	0	0	200.0	0
IV Other Capital Costs						
Administrative Office Equipment[c]	41.1	0	0	0	41.1	0
Quality Control Equipment[c]	575.7	0	0	0	575.7	0
Consumer Protection[c]	377.4	0	0	0	377.4	0
TOTAL	11,808.0	22,458.6	10,411.8	24,913.5	22,219.8	47,372.1
TOTAL STATE & PRIVATE GARAGE	34,266.6		35,325.3		69,591.9	

[a] Costs are to the closest $100.

[b] 3,135 private garages would be participating in the program.

[c] Costs for statewide option are considered directly proportional to the number of stations participating in the program.

and software development for vehicle scheduling, and one time cost associated with vehicle scheduling.

2. Statewide Option - In contrast to the four county option, the total capital costs for 3,135 private garages at $6,000 per garage is $18.8 million. This will require an annualized cost for capital equipment $700 per year per private garage. The private garage operation costs over the 10-year period is $28.5 million or $9,000 per private garage. This amounts to $900 per private garage per year and a total cost per year for capital and operation costs of $1,600.

The statewide operation costs of each private garage is less because they will not inspect as many vehicles per garage as in the four county option. The operating costs per vehicle is equal for each option.

The state cost of $22.2 million or an average of $2.22 million per year over the 10-year program is to cover 1) 15.1 million for operating administrative costs to support analyses of data, prepare reports, administer the program, investigate complaints and consumer protection, $5.7 million for increased quality control of the 3,135 private garages, 2) initial implementation costs of $202,000 and $200,000 for public information, and 3) other capital costs of approximately 1 million consisting of $41,000 for administrative equipment, $575,000 for quality control equipment and $377,000 for consumer protection capital cost.

The state costs increase was considered to be proportional to the large increase of participating private garages which was a 4.7 fold increase over the four county options.

The total operating and capital cost for the statewide option program is approximately $69.5 million. The gross estimate under this option was to provide general comparative data only.

b. Comparison of State Manpower Requirements

Table 7 lists the State personnel requirements for the four-county area and the statewide program options. The State personnel requirements do not have a one-to-one correspondence to the number of vehicles because the minimum effort of program administration is independent of the number of vehicles. For example, the number of inspection agents is based upon a calibration check at each station every two weeks.

Program management responsibilities for either option will include: 1) vehicle test scheduling, 2) record maintenance, 3) establishment and review of emission test limits, 4) data analyses to determine inspection program effectiveness, 5) evaluation of current and future equipment needs, and 6) provision for future analyses and development. These program responsibilities will be coordinated by three key state personnel positions: 1) Quality Control Assistant Program Administrator, 2) Testing Assistant Program Administrator, and 3) Environmental Engineer. The specific responsibilities for each management position is outlined as follows:

1. Assistant Program Administrator (Quality Control) - Will manage the twice-monthly equipment calibration checks for all private-garage inspection centers; the statistical analysis of emission test data.

2. Assistant Program Administrator (Test) - Will be responsible for the efficient day-to-day operation of referee test stations.

3. Environmental Engineer - Is responsible for monitoring program effectiveness and evaluation of vehicle emission reduction.

3. Consumer Fee

In order to compute consumer fee, the program costs for the four-county and statewide options in Tables 5 and 6 were converted into annualized costs. This was done by amortizing capital-related (categories I, IV, and V) over 10 years of program operation. Results are presented in Tables 8 and 9. Cost of capital was assumed to be 6 percent.

Table 7. I/M STATE MANPOWER REQUIREMENTS

JOB CATEGORY	FOUR-COUNTY AREA	STATEWIDE
Program Administrator	1	1
Assistant Program Administrator (Quality Control)	1	1
Assistant Program Administrator (Testing)	1	1
Environmental Engineer	1	2
Statistician	1	2
Clerical	4	8
Secretaries	1	2
Inspection Agents	10	43
TOTAL	20	60

Table 8. ANNUALIZED COSTS OF I/M PROGRAM[a,b] - FOUR COUNTIES
(1978 DOLLARS)

CATEGORY	TOTAL AMORTIZED COST[c]	AVERAGE ANNUALIZED COST ($/YR)
I. Test Equipment Cost private garage	$2,013,000 x 0.2374 x 5[d] + $2,013,000 x 0.2374 x 5[d] = $4,779,900	$4,778,862/10 = $477,900
II. Operating Costs		
private garage		$9,914,500/10 = $991,500
state		$3,233,000 + 1,224,000/10 = $445,700
III. Initial Implementation Costs - state	$61,500 x 0.1359 x 10 = $83,600 $200,000 x 0.1359 x 10 = $272,000	(83,500 + 72,000)/10 = $35,600
IV. Other Capital Costs - state	(8,500 + 119,000 + 78,000) x 0.1359 x 10 = $279,300	$279,300/10 = $27,900 27,900
Total - State		$ 509,300
Private Garage		$1,469,400
State and Private Garage		$1,978,000

[a] All costs are rounded off to hundred dollars

[b] Basic cost data is taken from Table 5.

[c] Amortization factor (F) is determined by the formula

$$F = \frac{2(1+i)^n}{(1+i)^{n-1}}$$, where i is the cost of capital (=6%) and n is the number of years

For equipment amortization of 5 years, F = 0.2374
For capital amortization of 10 years, F = 0.1359

[d] The equipment life is considered to be 5 years, therefore, it is required to replace equipment after 5 years.

NOTE: Fee Calculation

$$\text{private garage share} = \frac{\$1,469,400}{622,200 \text{ vehicles}} = \$2.36$$

$$\text{state share} = \frac{\$509,300}{622,200 \text{ vehicles}} = \$0.81$$

TOTAL FEE $3.17

Table 9. ANNUALIZED COSTS OF I/M PROGRAM[a,b] - STATEWIDE
(1978 DOLLARS)

CATEGORY	TOTAL AMORTIZED COST[c]	AVERAGE ANNUALIZED COST ($/YR)
I. Test Equipment Cost private garage	$9,405,000 x 0.2374 x 5[d] + $9,405,000 x 0.2374 x 5[d] = $22,327,500	$22,327,500/10 = $2,232,700
II. Operating Costs private garage	$28,562,100 facility operating	$28,562,100/10 = $2,856,200
state		(15,105,000 + 4,718/500)/10 = $2,082,400
III. Initial Implementation Costs - state	$202,000 x 0.1359 x 10 = $274,500	$274,500/10 = $27,500
IV. Other Capital Costs state	(41,100 + 575,700 + 377,400) x 0.1359 x 10 = $1,351,100	$1,351,100/10 = $135,100
Total - State		$5,088,900
Private Garage		$2,245,000
State and Private Garage		$7,333,900

[a] All costs are rounded off to hundred dollars.

[b] Basic capital and operating cost data is taken from Table 6.

[c] Amortization factor (F) is determined by the formula.

$F = i(1 + i)^n / 1 + i)^n - 1$ where i is the cost of capital (= 6%) and n is the number of years.
For equipment amortization of 5 years, F = 0.2374
For capital amortization of 10 years, F = 0.1359

[d] Equipment life is considered 5 years, therefore, it is required to replace equipment after 5 years.

NOTE: Fee Calculations

$$\text{private garage share} = \frac{\$5,088,900}{2,103,000 \text{ vehicles}} = \$2.42$$

$$\text{state share} = \frac{\$2,245,000}{2,103,000 \text{ vehicles}} = \$1.06$$

TOTAL FEE $3.48

The average consumer fee to defray the four-county I/M program cost was estimated to be $3.17 per vehicle (in 1978 dollars). The state's share is $0.81 while the private garages's share is $2.36. The fee is derived by dividing total annualized costs in 1978 dollars by the vehicle population of 622,200 in year 1986. The fee allows one retest of a failed vehicle.

The average consumer fee to defray the statewide option I/M program cost was estimated to be $3.48 (see Table 9). The state's share is $1.06, while the private garage's share is $2.42. The average vehicle population for the statewide option was 2,103,000 vehicles. The increased cost for the statewide option is because the costs of equipment and operations requrements of 3,135 participating private garages. The participating garages for the statewide program would be testing fewer vehicles then the participating stations in the four-county option.

It should be noted that the fee covers only the State's direct cost on the I/M program and certain indirect costs, such as utilities/supplies, office rental, etc. It is difficult to include all governmental indirect costs in this study without a detailed knowledge of the state's general accounting procedure.

4. Costs of Repair

The maintenance of the I/M program involves the repair of those vehicles which were identified as high emitters; the level of preventative maintenance requested by vehicle owners; and any unnecessary repairs by the service industry.

Recent Arizona I/M experience revealed that the average cost of repairs of failed vehicles was $23.20 during 1977 based upon average repair cost for 1968 to 1977 model years with market distribution set forth in Table 10. These costs ranged from zero for warranty repairs to over $600. for an engine overhaul. Table 10 presents the average cost of repairs for various model-year groupings in different facilities performing the repairs.

Table 10. ARIZONA SERVICE INDUSTRY REPAIR COST FOR FAILED VEHICLES

TYPE FACILITY	1964-1967	1968-1977	1964-1977	MARKET SHARE PERCENTAGE
Franchised dealers	$41.25	$26.82	$27.97	13
Service stations	23.06	19.81	21.14	15
Merchandisers	15.53	20.29	19.43	3
Tune-up specialists	36.19	22.86	24.72	3
Independent garages	21.33	27.46	26.79	27
"Do-it-yourselfers"	14.27	20.61	19.08	39

Source: Ref. 2.

Moreover, Table 11 presents vehicle percent contribution to various repair cost categories for Arizona, Oregon, and New Jersey. Again the repair costs are less than $10 for 29.8 to 66 percent of the vehicles tested. Lower repair costs are attributed to carburetor adjustments, rather than expensive tune-ups or engine repairs. The median value of $15 in the Arizona repair costs would indicate when comparing it to the average cost of $23.20 that the majority of vehicles have low repair costs and a few vehicles may have high repair costs.

Table 11. REPAIR COST SUMMARY FOR EXISTING I/M PROGRAMS

ITEM	ARIZONA	OREGON	NEW JERSEY
Repair Costs			
Less than $10	44%	64%	29.8%
$10 to $25	24%	21%	26.4%
$25 to $50	20%	8%	22.1%
$50 to $100	10%	5%	16.1%
More than $100	2%	2%	5.6%
Number of Vehicles	2,000	1,400	1,600
Median Repair Costs	$15	$8	$20
Percent of Repairs less than average cost	64%	71%	65%

Ref. 8

Other studies, however, indicated the average repair cost would be approximately $36. (in 1977 dollars). (Ref. 3, 4, 5, 6.) Some states have placed a cost ceiling on the amount of repair.

5. Emission Reduction Benefits

The levels of emission reduction that result from the implementation of I/M programs depends on the number of vehicles inspected, stringency factor*, function, and also on the travel characteristics in the county where the vehicles are registered.

The calculation of emission reduction as a result of I/M implementation was based on results obtained from the EPA-supported MOBILE 1 computer program. This program enables the user to apply I/M program credits to emission factor estimates by inputting a stringency factor and vehicle model-year applicability. Emission levels developed by MOBILE 1 program, presented in Tables 12 and 13, detail HC/CO emission levels without I/M; with I/M; and percent emission reduction from I/M implementation; for county and statewide geographic options.

This information was provided for 1982 and 1987 I/M program years using 1977 as a base year. The second column for HC and CO shows total emissions in 1977. The third and sixth columns show emissions expected in 1982 and 1987 without an I/M program. The lower figures for both years are attributable to the Federal Motor Vehicle Emission Control Program (FMVCP). The fourth and seventh columns show the amount of emission reduction that would occur with FMVCP and an I/M program. The fifth and eighth columns show the actual percent emission reduction that may be achieved through implementation of an I/M program. In all instances, the percent reduction for each county closely approximates percent reduction values achieved over the entire state.

6. Fuel Economy Benefits

One of the important benefits of I/M programs, in addition to the reduction in vehicular emissions, is fuel conservation. A properly tuned engine operates with greater efficiency, and therefore, consumes less fuel. This improvement in fuel economy varies somewhat from one program to another but most sources agree up to a 10-percent fuel economy improvement can be expected between the failed and maintained vehicles.

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*Stringency factor refers to the percentage of total vehicles tested in an I/M program, in a given time period, that fail inspection and are required to have maintenance performed.

Table 12. HC EMISSION REDUCTION WITH AND WITHOUT IMPLEMENTATION OF I/M PROGRAM FOR 1977 (Base Year), 1982, AND 1987 (Tons Per Year)

COUNTY	1977	1982			1987		
	WITHOUT I/M	WITHOUT I/M	WITH I/M	% REDUCTION	WITHOUT I/M	WITH I/M	% REDUCTION
1. Lexington	5,961	3,962	3,748	5	2,313	1,793	22*
2. Richland	10,376	6,148	5,790	6	3,499	2,670	24*
3. Berkeley	2,421	1,527	1,434	6	919	697	24*
4. Charleston	9,205	5,335	5,028	6	2,920	2,216	24*
Total	27,963	16,972	16,000	6	9,651	7,376	24*
Statewide	89,662	56,086	52,785	6	31,870	24,358	23*

SOURCE:: Ref. 6

*Although the 1987 percent reduction does not meet the EPA reduction of 25 percent as specified in Reference 1, the percent reduction could be within the error potential of the MOBILE1 program and the State of South Carolina should not have any difficulty in meeting the required percent reduction with the planned I/M program.

Table 13. CO EMISSION REDUCTION WITH AND WITHOUT IMPLEMENTATION OF I/M PROGRAM FOR 1977 (Base Year), 1982, AND 1987 (Tons Per Year)

COUNTY	1977	1982			1987		
	WITHOUT I/M	WITHOUT I/M	WITH I/M	% REDUCTION	WITHOUT I/M	WITH I/M	% REDUCTION
1. Lexington	43,973	38,548	32,552	16	25,903	17,459	33
2. Richland	79,829	60,983	51,112	16	39,160	25,944	34
3. Berkeley	17,581	14,684	12,278	16	10,116	6,609	35
4. Charleston	71,793	53,356	44,626	16	32,715	21,456	34
Total	214,176	167,571	140,568	16	107,894	71,468	34
Statewide	683,540	552,835	463,754	16	356,300	236,010	34

SOURCE: Ref. 6

An I/M program is to give an incentive to motorists to maintain their cars better than they normally would in the absence of I/M. This maintenance would increase vehicle-life and prevent problems such as vehicle stalling.

A 3.8 percent fuel economy improvement, per failed vehicle per year (as established from California programs), was used in this study to calculate fuel and dollar savings for the I/M program options. As shown in Table 14, the four-county I/M option would save 5.48 million gallons of fuel in 1982 and 4.07 million gallons in 1987. At $0.70 per gallon, vehicle owners would save $3.84 million and $2.85 million for 1982 and 1987, respectively. If coverage is extended to include the entire state, motorists would save 18.10 million gallons in 1982 and 13.45 million gallons in 1987. This amounts to $12.67 million and $9.41 million for 1982 and 1987, respectively.

Table 14. ESTIMATED ANNUAL FUEL ECONOMY BENEFITS FOR FAILED VEHICLES[a]

OPTION	1982 SAVINGS[b]			1987 SAVINGS[c]		
	Fuel[d] Mil. Gal	$ Million	Per Vehicle	Fuel[d] Mil. Gal	$ Million	Per Vehicle
1. Four-County (Lexington, Charleston, Berkeley, Richland)	5.48	$ 3.8	$7.14	4.07	$2.85	$4.46
2. Statewide	18.10	$12.67	$7.14	13.45	$9.41	$4.46

[a]See Section 4-D of the final report for computation details.

[b]Fleet average fuel efficiency is assumed to be 15 miles per gallon.

[c]Fleet average fuel efficiency is assumed to be 24 miles per gallon.

[d]Average miles traveled per year is 11,500 miles per year.

In terms of fuel savings per vehicle, it would be $7.14 in 1982 and $4.46 in 1987. Less fuel savings per vehicle in 1987 is anticipated because of higher fuel efficiency of automobiles. Moreover, the motorist who repairs his failed vehicle will realize a saving in fuel cost as an offset to the repair cost.

7. Indirect Impacts and Political Issues

In addition to the primary benefits of reducing vehicular emissions, fuel savings, and improving air quality, I/M programs have indirect benefits and bearing on political issues. To discover what the potential benefits and poltical issues might be, other I/M programs were reviewed.

a. Indirect Benefits

There are several indirect benefits that do not relate to specific options but would result from the implementation of any I/M program option. These include the following:

- Improved health benefits (less respiratory problems, etc.)
- Improved vehicle performance and vehicle life
- Increased agricultural production
- Reduction of airborne particulates
- Reduction of sulfur oxides, carbon monoxide, ozone, and nitrogen oxides
- Improvement in visibility
- Conservation of energy

The improvement in air quality in those areas where the NAAQS are currently exceeded are likely to have some benefits in the health of the affected population.

The amount and nature of the benefits would depend on the severity of air pollution prior to the implementation of the I/M program, and the amount of reduction in air pollution resulting from I/M. However, a recent publication

"Clean Air for South Caroline - How Our State Stands", identified several areas throughout the State that experienced 300 to 350 days of stagnant weather conditions.

b. Political Issues

Political issues surrounding an I/M program are:

- o Impacts on low-income citizens
- o Potential overcharging for repairs and performance of unnecessary repair work
- o Problems of conflict of interest and uniformity of inspection in the private-garage approach

I/M programs have the potential of placing a burden on low-income citizens by forcing them to make expensive repairs for failed vehicles. This could force low-income people who own older vehicles to make needed repair that exceed the value of the vehicle. This problem has been reduced by instituting repair cost ceilings. Thus, if the cost of the repairs needed to meet the standard exceed a cost ceiling, then the vehicle could receive an inspection waiver. A cost ceiling, if implemented, could create administrative problems.

The problem of dealing with repair overcharging or unnecessary repair work can be dealt with in several ways. Some states have instituted recommended repair procedures that are specified for various emission failure problems. These procedures range from an idle adjustment to a low emission tune-up. Mechanic training programs will result in a higher level of repair competence and motivation. Consumer protection programs can be designed to identify those garages that charge significantly more than the average repair cost or identify garages generally drawing numerous consumer complaints. Such procedures can be relatively informal or can be tied in with formal licensing of garages and mechanics.

The options with inspection, as well as repair, in licensed private garages may pose quality assurance and consumer protection problems. With a large number of garages having emission analyzers of varying degrees of quality, and with less uniform supervision, there will probably be less uniformity of the inspection in private garages. Moreover, there is an inherent conflict of interest in having the same garage conduct both the testing and maintenance phase of I/M.

Public Information Program - Many questions raised by I/M implementation can be properly addressed through a well-designed and comprehensive public information program. It can help to eliminate adverse public criticism by stressing the purpose, objectives, benefits, and operation of I/M. Emphasizing the checks and balances (e.g., quality assurance) designed into the I/M program, and health benefits from emission reductions, will alleviate many problems associated with the implementation procedure.

A public information program can address other benefits to the vehicle owner. Improvements in fuel economy, vehicle performance and longevity are important to vehicle owners. Control of vehicles that emit annoying quantities of smoke, and assurances that I/M requirements will extend to all vehicles, are important points to stress.

This can be accomplished by effective use of advertising techniques that utilize the mass communication media (e.g.; radio, television, newspapers, etc.), information centers, education programs, citizen group contacts, etc. In the early stages of I/M implementation, initial program information should explain the following:

- Need for an I/M program
- Explanations that specify derived benefits from automotive emission inspection and maintenance
- Cost and benefit of an I/M program for in-use vehicles
- Explanations of the inspection procedure

Supplemental information is required after the public has accepted the need to understand the concepts of I/M. This additional information includes:

- The location of test facilities and private garage responsibilities in the program
- Instructions and fee requirements
- Explanation of basic idle test requirements and retest requirements and conditions
- Importance for allowing time for repair and retest, or considerations for waiver (if implemented)
- Explanation of complaint referral system
- Explanation of area covered by I/M program
- Explanation of maximum repair level, average repair, carburetor and ignition functions and major repair problems

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